# APPENDIX F: SPACE SYSTEMS WORK BREAKDOWN STRUCTURE AND DEFINITIONS

## F.1 SCOPE

This appendix provides the Work Breakdown Structure and Definitions for the Space Vehicle, Ground Command, and Launch Vehicle. Definitions for WBS elements common to the space system and all other defense materiel items are in Appendix I: Common Elements, Work Breakdown Structure and Definitions

## F.2 APPLICABLE DOCUMENTS

If there are high cost/high risk elements that must be reported below Level 4 for Space Subsystems and/or for Ground Systems of the WBS, users should reference the National Reconnaissance Office (NRO) Standard Work Breakdown Structure (NRO SWBS) in order to ensure consistency in reporting. The NRO SWBS can be found at the following site:

http://www.acq.osd.mil/pm/currentpolicy/wbs/Releasable SWBS-locked.doc

## F.3 WORK BREAKDOWN STRUCTURE LEVELS

| Level 1 | Level 2 | Level 3 | Level 4 |
|---|---|---|---|
| Space System | | | |
| | SEIT/PM and Other Common Elements | | |
| | Space Vehicle (1….n as required) | | |
| | | SEIT/PM and Other Common Elements | |
| | | Spacecraft Bus | |
| | | | SEIT/PM and Other Common Elements |
| | | | Structures and Mechanisms Subsystem |
| | | | Thermal Control Subsystem |
| | | | Electrical Power Subsystem |
| | | | Attitude Control Subsystem |
| | | | Propulsion Subsystem |
| | | | Telemetry, Tracking, and Command Subsystem |
| | | | Spacecraft Bus Flight Software |
| | | Communication / Payload | |
| | | | SEIT/PM and Other Common Elements |
| | | | Communication (1…n as required) |
| | | | Payload (1…n as required) |
| | | | Communication/Payload Flight Software (1…n as required) |
| | | Booster Adapter | |
| | | Space Vehicle Storage | |
| | | Launch Systems Integration | |
| | | Launch Operations & Mission Support | |
| | Ground (1…n as required) | | |
| | | SEIT/PM and Other Common Elements | |
| | | Ground Terminal Subsystems | |
| | | Command and Control Subsystem | |
| | | Mission Management Subsystem | |
| | | Data Archive/Storage Subsystem | |
| | | Mission Data Processing Subsystem | |
| | | Mission Data Analysis and Dissemination Subsystem | |
| | | Mission Infrastructure Subsystem | |
| | | Collection Management Subsystem | |
| | Launch Vehicle | | |

F.3.1 Application of Common WBS Elements (Appendix I). Common WBS Elements must include, as a minimum, systems engineering, integration and test, and program management (SEIT/PM). Common elements are found throughout all levels of a WBS and are located one WBS level below the product oriented WBS they support (e.g., structures and mechanisms SEIT/PM would be captured at Level 5 below the Structures and Mechanisms Subsystem). Other common elements, such as training or data, as applicable, may be included here. The table above is not complete without the application of common elements

## F.4 DEFINITIONS

F.4.1 Space System. The complex of equipment (hardware/software) and all of the resources associated with the design, development, production, integration, assembly, test, and operation of the entire Space System.

Includes, for example:

a. Space Vehicle; Ground; Launch Vehicle; and any mission equipment or other items necessary to provide an operational capability in space.
b. Any efforts done within a development/acquisition contract and includes such things as Operation and Maintenance Plans and Integrated Logistic Support Plans

F.4.2 Space Vehicle (1… n as required). A complete space vehicle in a multiple or dissimilar space vehicle configuration. It contains all of the resources associated with the design, development, production, integration, assembly, and test to include verification testing of each space vehicle as required. List each unique configuration as a separate space vehicle using sequential indices for each configuration; e.g., first configuration is Space Vehicle 1, second configuration is Space Vehicle 2, etc.

Includes, for example:

a. The design, development, and production, integration, assembly, test, and checkout of complete units (i.e., the prototype or operationally configured units which satisfy the requirements of their applicable specification, regardless of end use)
b. Sub-elements to the space vehicle -Spacecraft Bus, Communication/Payload; Booster Adapter; Space Vehicle Storage; Launch Systems Integration; Launch Operations and Mission Support (F.4.2.1-F.4.2.6)

F.4.2.1 Spacecraft Bus. The principal operating space vehicle that serves as a housing or platform for carrying a payload and other mission-oriented equipment in space.

Includes, for example:

a. Structure, power, attitude determination and control, and other equipment characteristic of a spacecraft bus
b. All design, development, production, and assembly, test, and checkout efforts to provide the spacecraft bus as an entity for integration with other WBS Level 3 elements (i.e., Communication/Payload Equipment) hardware elements
c. Sub-elements to Spacecraft Bus-Structures and Mechanisms (S&M); Thermal Control (TCS), Electrical Power (EPS), Attitude Control (ACS), Propulsion (PS), Telemetry, Tracking, and Command (TT&C) subsystems; Bus Flight Software where the software cannot be broken out to the subsystem or component level; (F.4.2.1.1-F.4.2.1.8)

**NOTE: On more complicated Space Vehicles, there may be an integrated multi-processor system that performs functions for both the Bus and Payloads. In these cases it is acceptable to consider the Multi-Processor system as a single payload or as part of a specific payload. The Multi-Processor System may integrate functions normally included under ACS, TT&C, Communication & other payloads. The relevant point is to keep the cost in a single element and not allocate over multiple WBS elements.**

F.4.2.1.1 Structures and Mechanisms Subsystems. The complete structures and mechanisms subsystem that supports all space vehicle subsystems, including deployable elements, during launch, and on-orbit injection.

Includes, for example:

a. All the resources associated with the design, development, fabrication, assembly, quality control/assurance, and test to include verification testing of spacecraft bus structure, mechanisms, structures with integral (non-removable) thermal control, pyrotechnics, and support equipment
b. Equipment compartments, trusses, frames and shells for carrying primary loads; and secondary structures for equipment support; structural assemblies for interfacing with the booster adapter and/or with the launch vehicle
c. All load carrying devices, such as payload equipment panels that are provided to Communication/Payload equipment supplies for supporting Communication/Payload Equipment components
d. Cables, harnesses, and end items which deploy and support solar arrays, antennas and other spacecraft components to the extent that the mechanisms are separable from the components they support

Excludes, for example:

a. Positioning elements that are identified with specific elements they support, such as solar array positioners
b. Payload fairings which are included in the launch element
c. Small equipment compartments or pallets that house Communication/Payload electronics are part of Communication/ Payload element
d. Booms which are used to exclusively support Communication/Payload equipment components or assemblies in the Communication/Payload element

F.4.2.1.2 Thermal Control System. The thermal control subsystem maintains the temperatures of all spacecraft bus components, and those Communication/Payload suites without their own thermal control provisions, within acceptable limits during ground test, launch and on-orbit operations.

Includes, for example:

a. All the resources associated with the design, development, fabrication, assembly, quality control, and test to include verification testing
b. Active or passive components including cryogenic devices, liquid loops, electric cooling, multi-layer thermal insulation blankets, surface coatings (thermal paint), mirrors with optical coatings, coatings, thermal tape, heat pipes, heat sinks, insulation, conductive structures, louvers, sun shields, active coolers, heaters, thermisters, thermostats, shutters, thermal conducting elements, and radiator panels/fins, coatings, insulation, louvers, sun shields, and thermal control subsystem flight software (including algorithm development), and support equipment.

**NOTE 1: In cases where Communication/Payload contains its own thermal control provisions, the thermal control components are included in the Communication/Payload WBS element**

**NOTE 2**: **When a space vehicle structure item has integral (non-removable) thermal control provisions such as heat sinks, then that item and its integral provisions are included within the Structures and Mechanisms Subsystem**

F.4.2.1.3 Electrical Power Subsystem. This subsystem generates, converts, regulates, stores, and distributes electrical energy to spacecraft bus and Communication/Payload suites.

Includes, for example:

a. All the resources specifically related to and limited to the design, development, fabrication, assembly, quality control, and test to include verification testing of electrical power subsystem
b. Power generation, conditioning, and storage; Electric Power Subsystem software; support equipment; and electrical harnesses and cables
c. Electric power generation: solar array (to include substrates, solar cells, support structure), solar array positioner (to include drive assembly and drive electronics), radioisotope thermionic generator, other power sources,
d. Electric power conditioning: power control electronics (to include junction boxes and pyrotechnics/heater controls), power conversion electronics (to include inverters, converters and regulators), power dissipation devices (to include shunt resistor banks and dissipators)
e. Electric power storage: rechargeable batteries (to include cells, support structure and interconnects), charge control electronics

F.4.2.1.4 Attitude Control Subsystem. This subsystem determines and controls spacecraft orbital positions, attitudes, velocities and angular rates using onboard sensors and torque application devices. It may also send control signals to propulsion subsystem components (e.g. thrusters), electrical power subsystem solar array positioners, and communication/ payload positioner electronics.

Includes, for example:

a. All the resources specifically related to and limited to the design, development, fabrication, assembly, quality control, and test to include verification testing of the Attitude Control Subsystem
b. Attitude determination: attitude reference (to include star trackers/sensors, earth (horizon) sensors, sun sensors, magnetometers), inertial reference (to include inertial reference unit, rate gyros, accelerometers), Bearing and Power Transfer Assembly (BAPTA), and Global Position System (GPS) Receiver
c. Attitude control: gyro stabilization devices (to include reaction wheels, momentum wheels, control moment gyros, energy storage devices (flywheels)), magnetic control devices, spin control devices, control electronics),
d. Attitude control subsystem flight software, and attitude control subsystem support equipment
e. May also include sensors, electronics and mechanical devices for safe-mode control of the space vehicle

**NOTE: If lower level information can be collected, use the structure and definitions in Appendix B, Electronic/Automated Software Systems.**

F.4.2.1.5 Propulsion Subsystem. This subsystem provides thrust for attitude control and orbit corrections as required to accomplish the specified mission. It also provides thrust for orbit injection and changes.

Includes, for example:

a. All the resources specifically related to and limited to the design, development, fabrication, assembly, quality control, and test to include verification testing of the propulsion subsystem
b. Tanks, plumbing, thrusters, solid rocket motors, liquid propellants, and support equipment

**NOTE: If lower level information can be collected, use the structure and definitions in Appendix B, Electronic/Automated Software Systems.**

F.4.2.1.6 Telemetry, Tracking, and Command (TT&C) Subsystem. This subsystem performs functions such as: formatting and transmitting telemetry (on narrowband links); accepting, decoding, verifying, and storing uplink commands; and generating command and control signals for the spacecraft bus and communication/payload suites based on uplink commands and/or internally generated data. The TT&C subsystem may also: provide timing signals to the spacecraft bus and communication/payload suites; perform on-board attitude determination, ephemeris calculations and attitude control equipment control (if these are not performed by dedicated attitude control computers/electronic components); and perform thruster control, electrical power monitoring/and control (if these are not performed by dedicated propulsion subsystem and electrical power subsystem components, respectively).

Includes, for example:

a. All the resources specifically related to and limited to the design, development, fabrication, assembly, quality control, and test to include verification testing of the TT&C
b. Passive radio frequency (RF) components (such as antennas, RF plumbing), other RF (such as transmitters, receivers, transponder, modulators, demodulators, power amplifiers, traveling wave tube assembly, solid state power amplifiers, GPS receivers, downconverters, and upconverters), other electronics (such as processors, solid state memory, decoders, command units, telemetry units, command sequencers, timing units, frequency generators, signal conditioners, and data switches), TT&C System Software (including algorithm development), and support equipment

**NOTE: If lower level information can be collected, use the structure and definitions in Appendix B, Electronic/Automated Software Systems.**

F.4.2.1.7 Spacecraft Bus Flight Software. All resources required to design develop, code, test, document, install, integrate and verify flight software for performing spacecraft functions.

Includes, for example:
a. Designing, developing, coding and testing those functions that are implemented in firmware (e.g. by microcode programming).
b. Algorithm development

**NOTE 1: If lower level information can be collected, use the structure and definitions in Appendix B, Electronic/Automated Software Systems.**

**NOTE 2: If flight software cannot be separated to the Spacecraft Bus subsystems or between the Spacecraft Bus and the Communication/Payload equipment, then the combined resources will be combined in this WBS. Otherwise, Software for performing Spacecraft Bus subsystems function or Communication/Payload equipment functions is included in the appropriate subsystem or Communication/Payload Equipment WBS elements.**

F.4.2.2 Communication/Payload. In some space vehicles a communications suite is the primary payload; in others, it is a secondary, but integral, element to transmit primary payload data to the ground segment and receive payload tasking from the ground segment. Thus, these two functions are combined at this level and segregated at Level 4 of the WBS.

Includes, for example:
a. All of the resources associated with the design, development, production, integration, assembly, and test to include verification testing of communication/payload suite
b. Communication suites, payload suites, flight software, and support equipment
c. Sub elements to communication/payload – communication, payload and communication/payload flight software (4.2.2.1-4.2.2.3)

Excludes, for example
a. Integration and assembly of the communication/payload into a spacecraft which is captured at the space vehicle level
b. Remote command and telemetry units supporting communication/payload which are in the TT&C subsystem

F.4.2.2.1 Communication. The Communication suite transmits and/or receives mission data between the host space vehicle, ground stations, and other space vehicles. The Communication suite may or may not include TT&C signals multiplexed with mission data.

Includes, for example:
a. All of the resources associated with the design, development, production, integration, assembly, and test to include verification testing of the Communication WBS, which consists of one or more Communication suites in a multiple Communication suite configuration
b. All required Communication suites

c. Structures and Mechanisms, Thermal Control, Optics, Sensor Package, Laser Photonics, Power Supplies, RF Electronics, Digital Electronics, Data Storage, Communication Antennas, Communication Flight Software (including algorithm development), Communication Support Equipment.

F.4.2.2.2 Payload. The Payload is the component of a space vehicle that performs the space mission. It may require support from the host vehicle bus, such as power and positioning, from ground systems and from other space systems.

Includes, for example:

a. All of the resources associated with the design, development, production, integration, assembly, and test to include verification testing of the Payload WBS, which consists of one or more Payloads in a multiple payload configuration
b. Remote command and telemetry components that interface with the Payload equipment and the TT&C subsystem for purposes of commanding Payload suites and monitoring their status
c. Hardware components such as antennas and efforts that are used for both TT&C and mission data transmit/receive functions
d. Structures and Mechanisms, Thermal Control, Optics, Sensors, Lasers, Power Supplies, RF/Analog Electronics, Digital Electronics, Data Storage, Payload Antennas, Payload Flight Software (including algorithm development), Payload Support Equipment

Excludes, for example:

a. Hardware components and efforts that are devoted exclusively to TT&C functions (except the command and telemetry interfaces described above)

F.4.2.2.3 Communication/Payload Flight System Software. All resources required to design, develop, code, test, document, install, integrate and verify flight software for performing Communication/Payload functions.

Includes, for example:

a. If some of the functions are implemented in firmware, then includes designing, developing, coded and testing of those functions (e.g. by microcode programming).
b. Algorithm development

**NOTE 1: If lower level information can be collected, use the structure and definitions in Appendix B, Electronic/Automated Software Systems.**

**Note 2: If Communication/Payload cannot be separated between the Spacecraft Bus and the Communication/Payload equipment, then the combined resources will be carried in the Spacecraft Bus WBS.**

F.4.2.3 Booster Adapter. The booster adapter provides the mechanical and electrical interface between the launch vehicle's uppermost stage and the space vehicle. It can be as simple as a snap ring device, but it is usually a more complex structural assembly. In some

cases, the booster adapter may be integral with the space vehicle. Also, in other cases, it may be purchased along with the launch vehicle.

Includes, for example:
a. All of the material and effort associated with the design, development, production, integration, assembly, and test of the Booster Adapter
b. Adapter structures, attachment and release devices, thermal control, instrumentation, and umbilical provisions

F.4.2.4 Space Vehicle Storage. Those costs of holding portions of the space system while awaiting use of the system being stored, prepared for storage, or recovered from storage. It can include the costs of holding portions of the space vehicle while waiting for the use of test facilities and equipment or the completion of other portions of the space vehicle.

The storage period typically starts when production testing is complete and continues until the space vehicle is ready for shipping to the launch site.

Includes, for example:
a. Planning, preparation, storage, maintenance, removal, refurbishment, and retesting of the space vehicle and/or its subsystems
b. Costs for storage facility use and environmental control equipment

Excludes, for example:
a. Final space vehicle assembly after storing portions of the vehicle

F.4.2.5 Launch System Integration. The engineering studies and analyses required to integrate a space vehicle with its launch vehicle. This effort typically is performed by the space vehicle developer.

Includes, for example:
a. Space vehicle contractor studies, analysis, and tests supporting the integration of the space vehicle with the launch vehicle
b. Launch system integration hardware, if any, provided by the space vehicle contractor

Excludes, for example:
a. Booster adapter which is represented within its own WBS
b. Integration activities performed by the launch vehicle provider, which are included in the Launch Segment portion of the WBS

F.4.2.6 Launch Operations and Mission Support. Launch operations are those efforts performed by the provider(s) of the space vehicle and payload(s) to prepare for and support space vehicle launches, primarily at the launch base and, to a lesser degree, the space vehicle

factory. Mission support is performed by the same providers for initial on-orbit checkout of the space vehicle and may also continue through the operational phase of the program.

The mission support period typically begins shortly after launch and ends when the space vehicle achieves initial operational capability.

Launch Operations Includes, for example:

a. Satellite contractor effort associated with pre-launch planning and preparation; launch operations, and initial on-orbit operations provided by the producer/integrator of the Space vehicle and Ground portions of the Space System
b. Pre-launch preparation of the space vehicle for shipping and actual shipping of the space vehicle to the launch site
c. Space vehicle contractor participation in final assembly, checkout, fueling and launch activities
d. Space vehicle contractor telemetry review and analysis during boost phases and initial orbital operations

Mission Support Includes, for example:

a. Space vehicle contractor participation in on-orbit testing; routine monitoring of space vehicle equipment health and status; fault detection; and anomaly investigation and resolution

F.4.3 Ground (1…n as required). The Ground is defined as a fixed, transportable, or mobile assembly of hardware, software, and firmware that has a communications interface with a space vehicle to receive only, or to receive and transmit data generated and mission data collected by the space vehicle. In addition, space vehicle TT&C and mission data may be processed within collocated facilities or alternatively in remotely located facilities. For example, Ground 1 could represent a Space Operations Center and Ground 2 a Network Operations Center or some other type of Command and Control facility.

Includes, for example:

a. All of the resources associated with its design, development, production, procurement, integration, assembly, and test
b. Support for the Space System and Space Vehicle level integration and testing provided by the producer/integrator of the Ground portion of the Space System
c. Sub-elements to Ground-Ground Terminal Subsystem; Command and Control Subsystem, Command and Control System; Mission Management Subsystem; Data Archive/Storage Subsystem; Data Archive/Storage System and Application Software; Mission Data Processing Subsystem; Mission Data Analysis and Dissemination Subsystem; Mission Infrastructure Subsystem; and a Collection Management Subsystem.
d. Ground facilities/building, factory/contractor support facility, initial support and support equipment specific to the ground portion of the space system but are not associated with specific subsystems

F.4.3.1 Ground Terminal Subsystem. This subsystem receives, downconverts, demodulates, and conditions telemetry, tracking, command, and mission (payload) data. In

addition, this subsystem generates the radio frequency (RF) uplink, accepts tracking and command signals, and modulates them onto the RF uplink.

Includes, for example:

a. Resources associated with the design, development, production, procurement, assembly, test, and operational site activation of the ground terminal (GT)
b. Antennas, feeds, antenna positioners, antenna support pedestals, radomes, transmitters, receivers, up/down frequency converters, modulators, demodulators, front-end equipment (encryptors/decryptors, synchronizers), etc.
c. Ground terminal facilities/buildings, ground terminal factory/contractor support facility, ground terminal initial support, and ground terminal support equipment

**NOTE: If lower level information can be collected, use the structure and definitions in Appendix B, Electronic/Automated Software Systems.**

F.4.3.2 Command and Control Subsystem. The Command and Control subsystem decodes, demultiplexes, and decrypts space vehicle telemetry, generates commands for transmission to the spacecraft, and processes tracking data to generate space vehicle ephemeris. This subsystem supports all Ground subsystems that require the capability to prepare and output commands to, and receive and process data from, the space vehicle while in operation or under test

Includes, for example:

a. Resources associated with the design, development, production, procurement, assembly, test, and operational site activation of the Command and Control Subsystem.
b. Network, computer processing and display hardware such as routers, switches, servers, workstations, storage devices, etc.
c. Software for handling, processing, and executing space vehicle commands, as well as processing and analyzing space vehicle telemetry
d. Command and control ground facilities/building, command and control factory/contractor support facility, command and control initial support and support equipment

**NOTE: If lower level information can be collected, use the structure and definitions in Appendix B, Electronic/Automated Software Systems.**

F.4.3.3 Mission Management Subsystem. The Mission Management Subsystem receives tasking, generates and provides the daily and longer-term system and mission plans, schedules, and timelines for the locally controlled satellites and ground facilities.

Includes, for example:

a. Resources associated with the design, development, production, procurement, assembly, and test of the Mission Management Subsystem
b. Network, computer processing and display hardware such as routers, switches, servers, workstations, storage devices, etc. plus software for processing tasking requests, generating mission plans, assessing system performance and reporting results

c. Mission management ground facilities/building, mission management factory/contractor support facility, mission management initial support and support equipment

**NOTE: If lower level information can be collected, use the structure and definitions in Appendix B, Electronic/Automated Software Systems.**

F.4.3.4 Data Archive/Storage Subsystem. The Data Archive/Storage Subsystem receives daily and longer-term system and mission data and provides archive/storage for the locally controlled satellites and ground facilities.

Includes, for example:

a. All the resources associated with the design, development, production, procurement, assembly, test, and operational site activation of the Data Archive/Storage subsystem
b. Network, computer processing and display hardware such as routers, switches, servers, workstations, storage devices, etc.
c. Software (including algorithm development) for compiling, logging, tracking, allocating space, and data retrieval while assessing system performance and reporting results
d. Data archive/storage ground facilities/building, data archive/storage factory/contractor support facility, data archive/storage initial support and support equipment

**NOTE: If lower level information can be collected, use the structure and definitions in Appendix B, Electronic/Automated Software Systems.**

F.4.3.5 Mission Data Processing Subsystem. The Mission Data Processing Subsystem decodes, demultiplexes, and decrypts digital and/or analog mission data from space vehicle payloads and generates commands for payload control. This subsystem typically performs processing unique to the payload(s) on the space vehicle, as opposed to centralized processing of payload data from different types of space vehicles. This data processing could be pre-processing prior to forwarding mission data to a national processing center and/or complete end-to-end data processing for direct dissemination to users.

Includes, for example:

a. All the resources associated with the design, development, production, procurement, assembly, test, and operational site activation of the Mission Data Processing Subsystem
b. Network, computer processing and display hardware such as routers, switches, servers, workstations, storage devices, etc.
c. Software (including algorithm development) for performing pre-processing operations on the mission data such as reformatting, compressing, combining, and tagging. (It may also perform other “back end” processing functions).
d. Mission data processing ground facilities/building, Mission data processing factory/contractor support facility, Mission data processing initial support and support equipment

**NOTE: If lower level information can be collected, use the structure and definitions in Appendix B, Electronic/Automated Software Systems.**

F.4.3.6 Mission Data Analysis and Dissemination Subsystem. The Mission Data Analysis and Dissemination Subsystem is responsible for analysis of mission data from the payload(s) on the space vehicle. This mission data analysis could take various forms and could be interactive with a "human-in-the-loop" or automatic.

The dissemination function routes the received data and/or the final analysis products to the appropriate ground subsystems, archive/storage locations, and also to external users.

Includes, for example:

a. All the resources associated with the design, development, production, procurement, assembly, test, and operational site activation of the Mission Data Analysis and Dissemination Subsystem
b. Network, computer processing and display hardware such as routers, switches, servers, workstations, storage devices, etc.
c. Software (including algorithm development) for performing the mission data analysis and dissemination tasks
d. Mission data analysis and dissemination processing ground facilities/building, mission data analysis and dissemination processing factory/contractor support facility, mission data analysis and dissemination processing initial support and support equipment

**NOTE: If lower level information can be collected, use the structure and definitions in Appendix B, Electronic/Automated Software Systems.**

F.4.3.7 Mission Infrastructure Subsystem. The Mission Infrastructure Subsystem includes all COTS and custom hardware and software needed for 1) the interchange or transfer of wideband, narrowband data, command and control, telemetry, and other support data between system ground subsystems (e.g., between the Mission Data Analysis and Dissemination and Command and Control Subsystems), and 2) the transfer of communications between and among various programs operationally assigned to the ground site.

Includes, for example:

a. Resources associated with the design, development, production, procurement, assembly, test, and operational site activation of the Mission Infrastructure Subsystem
b. Converters, servers, switches, interface units, cabling, etc. that are needed to 1) convert data received by the receive facility, put it in the proper format, and send it to other subsystems within the system ground architecture, and 2) interchange or transfer communications within the ground site
c. Common software(including algorithm development) or operating systems that overarch 1) ground subsystems and are unique to the system ground architecture, and 2) other programs operationally assigned to the ground site
d. Addresses either an in-place Mission Infrastructure Subsystem or the build of a new subsystem. For an in-place system, this WBS addresses the construction, conversion, or expansion of the Mission Infrastructure Subsystem. For a new system, this WBS addresses the design, development, production, procurement, assembly, and test of the Mission Infrastructure Subsystem.
e. Mission infrastructure ground facilities/building, mission infrastructure factory/contractor support facility, mission infrastructure initial support and support equipment

**NOTE: If lower level information can be collected, use the structure and definitions in Appendix B, Electronic/Automated Software Systems.**

F.4.3.8 Collection Management Subsystem. The Collection Management Subsystem receives and analyzes space vehicle mission results, external customer and internal tasking requests, and generates tasking for space vehicles and ground facilities.

Includes, for example:

a. Resources associated with the design, development, production, procurement, assembly, test, and operational site activation of the Collection Management Subsystem
b. Network, computer processing and display hardware such as routers, switches, servers, workstations, storage devices, etc.
c. Software (including algorithm development) for processing mission results, tasking requests, generation of tasks, etc.
d. Collection management ground facilities/building, collection management factory/contractor support facility, collection management initial support and support equipment

**NOTE: If lower level information can be collected, use the structure and definitions in Appendix B, Electronic/Automated Software Systems.**

F.4.4 Launch Vehicle. This WBS includes the launch vehicle contractors' efforts to receive, store, and transport the launch vehicle and associated ground equipment; to stack and assemble the launch vehicle; to mate the space vehicle and the launch vehicle; to perform integrated system test and checkout; and to track and measure launch vehicle performance during the ascent phase.

This WBS also includes the procurement of commercial-like launch services, launch vehicle integration, and independent verification and validation (IV&V).

If the Booster Adapter is not captured under Space Vehicle, it should be captured within this element. Reference Appendix C Missile Systems for lower level elements associated with this element.